ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 10, 1881.

AT the meeting of the American Society on Wednesday evening, Mr. Ashbel Welsh occupied the chair, and there was a very full attendance of members. A committee on arrangements for the coming annual meeting in January was appointed, and it is expected that the meeting will extend over two days and prove very interesting and valuable to the attending members.

WE offer for every *new* subscription sent to us, with the money, a *cash premium* of *one dollar*, or *books* to the value of *one dollar and fifty cents*, and we prepay the postage on the books. If our readers will carefully review the past volume of ENGINEERING NEWS they will realize what a vast amount of information of value to engineers and contractors has been laid before them during the year. Can a more *newsy* class journal be named?

ONLY a few weeks of the present year remain, and we must again urge upon subscribers the necessity of securing back numbers while they can. Of some numbers we are entirely out, and it is useless to attempt to replace them; of such as are still on hand, we will fill orders while they last. After the close of the volume we will, without further notice, sell the remaining numbers as old paper; after which further chances for any part of this volume will be lost.

OF the original edition of Prof. Chas. E. Greene's "Graphical Analysis of Bridge Trusses," a work whose popularity has been steadily on the increase, there remain 110 copies. Last week we bought the entire lot and now offer them as an inducement for book buying, or for new subscribers. It is hardly necessary at this day and date, to specify the merits of this work, the enlarged edition of which is the very best selling book (at $2.50), on bridge construction now in the market. We will give one copy of the old edition for $1.25 cash, for one new subscriber, or free to the purchaser of three dollars worth of other books.

ORDERS FOR BINDING volumes of ENGINEERING NEWS will not be taken at this season of the year. In the holiday months and until well into the ensuing year, every available foot of storage room of the best binderies is occupied; from floor to roof unbound literature is packed away, much of it without insurance, and to the unaccustomed observer, in extricable confusion from which it might apparently never be rescued. As the summer months approach there is a better chance in job work, at better prices, and with a reasonable chance for completion. About May next we will take such orders for binding as may be sent us.

WE are indebted to the Indianapolis *News* for the correction of a paragraph which appeared in our last issue under the head of "Miscellaneous," and hasten to assure our readers that as a piece of news it appeared in a paper published so much nearer to Indianapolis than ourselves that we incautiously accepted it as something worth knowing. The fact of the city borrowing a certain sum of money to meet its expenses should have been sufficient evidence to one living in New York that the term bankrupt was scarcely applicable in the premises; and such reparation for its use as is afforded by this apology is cheerfully rendered.

OUR BOOK TRADE grows appreciably every succeeding day. No other bookseller in the United States is offering such inducements to buyers as we are. The Weale's series that we are *giving away* is not a collection of second-hand mutilated volumes, but it is the second largest and best stock of those popular works on this side of the Atlantic. We are daily filling the orders of booksellers from all over the country for them, and at regular trade rates. The best volumes are rapidly being taken, and with the renewal of subscriptions the stock will be pretty well thinned out by the additional orders for books. We advise intending book buyers to lose no time in sending us their orders if they would secure the advantage of our present offer of free books.

AS a very fair indication of the activity in all kinds of surveying operations, and especially in railroads, the following items from the bashful and silent Heller, of Messrs. Heller & Brightly, are offered:

"We found 33 North seventh street too small for us; we therefore purchased the four-story building at the southeast corner of Ridge Avenue and Spring Garden streets, making special arrangements for the delicate operations of graduating and adjusting of field instruments. As to business proper, the railroad boom has struck us badly, the Mexican railroad surveys especially almost devouring field instruments; we having literally sent them instruments for the last eighteen months by the hundred. Last January we had orders on our books for 310 transits and levels, and had refused more orders than we had accepted. We were therefore compelled to issue a notice that we could not accept any more orders for some months: in June we again put forth a similar notice, and the same state of affairs exists at the present time, our unfilled orders to-day (Dec. 7, 1881) amounting to 180 transits and levels."

As the season for renewal of subscriptions comes on, inquiries as to the rates of clubbing with other journals begin to be made. In reply we beg leave to state that we will pursue the same liberal policy that has always characterized the financial management of ENGINEERING NEWS. We will give to our subscribers *all* the discount allowed to us by other publishers, less five cents on each subscription, which we use to cover the expenses of attending to the business. The Harpers' and Century Company's publications will be the same as heretofore, and the increasing excellence of these magazines are too well known to need our indorsement. On class publications we must await the bills of the publishers; the average discount is 20 per cent. on new subscriptions; the *Sanitary Engineer* is 10 per cent.; the discount on renewals of the *Railroad Gazette* will hardly pay the cost of transmitting it, and the publishers are very loth indeed to accept renewals through outside parties. The best we can do is to do the best we can, which, as our patrons are well aware, is the principle upon which we are striving to serve them now and always.

WE notice in the *Railway Age* what the editor calls "an admirable method of developing information and directing thought to matters which may have attracted little consideration," viz., an order issued by the Chief Engineer of the N. Y., P. & O. Railroad, requiring each of the road masters on that road to have a written report, or answer to three of seventeen questions, on practical matters connected with their daily duties, embracing their individual views in reference to principles of construction on railroads, to be delivered and discussed at their annual meeting—nine were present.

Now with all due deference to the better judgment of the Chief Engineer, we should say that this was a step in the wrong direction. Let your road masters read as much as they can find time for from their most important daily duties on the road; but for Heaven's sake, do not stimulate or encourage a taste for writing.

It is the tendency of the day, and a most unfortunate one, to rush into print with matters so purely practical that the *truly* practical man would find it extremely difficult in putting them on paper. We have known road masters, and road masters whom we could ill spare, who would be incapacitated for their real duties while in the throes of birth of such productions; and, we must confess, that we should travel with some misgivings of safety on a road where we knew the road masters (as we understand their duties) were encouraged to strive for excellence in the preparation of written reports. The emulation thus incited might improve their style of composition, but it might be at the expense of other and more valuable improvement of their time in their responsible sphere of duty.

THE AMERICAN IRON MARKETS point in the direction of higher prices. With a few exceptions there is less probability of importations than for months. The cause is found in the steady upward tendency of the British markets. The occasion for this favorable condition is in a steadily improving continental and colonial demand, which absorbs current production and piles up orders for future execution. Foreign productive capacity is barely equal to demand. Enormous public works are projected on the continent; railway building on a large scale has been undertaken; the same is true of several of the British dependencies, notably Australia and Canada. Local requirements have assumed formidable proportions, and inquiries are pouring in for 1882. The activity in iron making is phenomenal. The efforts being made to meet the demand are on a scale of magnitude which requires only the factor of time to equalize supply and demand. There is no absolute scarcity in any department, but consumers felt it necessary to secure themselves by orders extending from two to twelve months ahead.

Prices are as high as it is safe for them to go without a further advance abroad. Very recent cablegrams point out the probability of such an advance. Still, it is not safe to rely on appearances. The British market takes very sudden changes, and that, too, without warning. Importers are still negotiating for supplies of bar iron, sheet blooms, plate and rails, new and old, but with very indifferent success, because of the firmness of prices abroad, the high ocean rates and the scarcity of material.

Within a few days large contracts have been placed for Bessemer, pig and blooms. Southwestern buyers have placed orders for steel rails. German makers have been applied to because of the oversold condition of British markets. Our steel rail mills are accepting a few orders at $60. The iron mills expect to turn on to steel blooms and thus, in a measure, compensate for the lack of converter capacity. It is evident that much of the consumptive demand which must be met before June will be obliged to seek European sources. A higher range of prices is quite probable. English mills are sold through the winter.

The rolling-mills are unable to meet all the demand presented. New boiling furnaces are being erected in a score of mills. Works making rolling-mill machinery are crowded with orders. The rolling-mill capacity will be very largely increased during the winter. Prices of iron are as follows: For finished, 2.6@3c., according to mill; structural

iron, 3@3¼c. to 4@4¼c.; plate iron, 3½c. These quotations are generally adhered to. Railroad, ship, engine and car builders have entered into spring contracts during the past ten days in both Eastern and Western mills for large supplies of iron.

The enormous consumption raises apprehensions that productive capacity will be unequal to the demand, but these fears have very slender foundation when we survey the entire field. A temporary advance is possible, in fact probable, due to the disappointment, and a happy one to many, of heavy iron and steel importations. Foreign supplies on a large scale were somewhat confidently looked for. They did not come, nor will not, and hence the present strong upward tendency in prices. But productive enterprise is expanding capacity at a rate never before known to the iron trade. Ore and fuel will be cheapened by the development of mines and increase of transportation facilities. Hence, consumers should take no alarm at any sudden spurt in prices.

SEWERAGE OF AMERICAN CITIES AND TOWNS.*

As may be expected in this document [referring to Mr. Rawlinson's "Suggestions"], the latter engineer, with proper professional discretion, does not take sides with either of the so-called rival systems, nor even mention them as such. On page 3 of the "Suggestions" he says, very properly: "That main sewers must not be of capacity to contain flood water, as such floods should be passed over the surface, or by special channels," and "in large towns there may be exceptions, as in London, where flood-water overflow channels may have to be formed." The observance of this obvious principle is precisely the cause of the complaints in the working of the Providence and Brooklyn system of sewers, with the failure of the authorities to provide the needed storm overflows; it having formed no part of the original scheme of sewering these cities to provide in the sewers proper for the excessive storms which visit the coast at intervals, and at the epochs of high tide.

Again, on page 7 of Mr. Rawlinson's "Suggestions," he states that duplicate systems of sewers are seldom required, and then proceeds to show "that if constructed, they would lead to complications tending to defeat the proposed uses." And while we may have been in error, nothing to which we have had access favors the idea that Mr. Rawlinson has ever been the advocate of the separate system, but as Mr. Latrobe states, he undoubtedly "recognized its claims to intelligent consideration." Mr. L. further truly states "that the prevalence of the combined system does not grow out of an original design, having in view the best system it was possible to devise, but to the relief of already existing systems of combined sewers, which had become nuisances."

After describing the Memphis system of small pipe mains, a population of 35,000, with twenty miles of sewer, with flushing tanks at the heads of the branches one hundred and twenty-five in number (the latter machines, by the way, paying a royalty of near twenty-five per cent. on the cost), he states that "the storm water can safely be left to take care of itself." And here we would say, in passing, that however admirable this disposal of the rain water might be in an unpaved city of the size, shape and character of subsoil of Memphis, it would prove an intolerable nuisance on the crowded Northern paved thoroughfares, and impervious subsoil of many of our cities.

The defects in the working of the Memphis system are then adverted to, but with an obvious leaning toward a charitable construction of their defects, as when he states that the population used about double the amount of water originally estimated for, "which filled the mains and occasioned a backing up of the sewage in the lower part of the city," and adds, "this fault of course was not incident, at all, to the system, but was an oversight in proportioning the mains, and would not be felt during an ordinary winter." If the mains are not liable to being choked or overcharged in the extension of the separate system, we have been greatly in error, and when convinced of it shall hasten to rectify it, but the fact of the actual consumption of water exceeding the estimated consumption, as shown in this case, and through this excess the sewage was backed into the houses, shows pretty clearly that the system offers no better compensation for irregularities of flow, so likely to arise in our growing cities, than is offered by the combined system. After satisfying himself of the working of the Memphis sewers, the Brooklyn and Providence systems were examined, but the facts in all cases are not given with sufficient care. For instance, in alluding to the infrequency of the man-holes in the line of the Brooklyn sewers, it is stated that they are built at intervals of "five hundred feet or more," whereas they were designed to be at intervals of one hundred feet, and except in storm sewers, or sewers of very large capacity, such as occur but seldom, they are built as designed, viz., at one hundred feet intervals, and the statements of the defects in the working of the system are somewhat exaggerated. The system was designed to provide for one inch of rain falling in an hour. As the pavements increased in area of course such storms as exceeded that amount, not being provided for, have given occasion for complaint.

Brooklyn, with a population of 560,000, has three hundred miles of sewers; about two-thirds are of pipe, and the remaining third of brick, the largest of the latter being equivalent to a circle of ten feet; and with eighteen outlets into the East River.

Providence, with a population of 100,000, has twenty-eight miles of pipe sewer, and fifteen and a quarter miles of brick, the largest of the latter being sixty-six-inch diameter, and with sixteen outlets into river and harbor.

The provision for carrying off rain-fall is the same in both; and the same difficulty appears, when, as in Brooklyn, the rain-fall occurring at high water, exceeds the amount to which the best judgment brought to bear on the subject has hitherto restricted the capacity of the sewers.

Having taken these two cities as representing the best practice of the "combined system," the necessities of Baltimore are then considered as follows:

Taking the population to be provided for in Baltimore at 500,000, with a water supply of 75 gallons per head, he arrives at 5,000,000 cubic feet in twenty-four hours, and with a minimum grade of $\frac{1}{1000}$, and disregarding entirely any accession to the sewers of rain water from street, areas or roofs, provides an outfall sewer of five feet in diameter, and recommends the Memphis system of small sewers, restricted to the discharge solely of house sewage, by which we understand in bulk, the water supply.

Proceeding to determine the anticipated quality of this sewage, with a view to the determination of the suspended solids delivered daily at the outlet, he procured some bottles of Memphis sewage from the main outfall of that city for analysis, and finds 129 parts of solid matter in 100,000 parts by weight, 114 of which are in suspension, and 15 in solution; and as the Memphis water supply was taken at 40 gallons per head, and the Baltimore supply is estimated at 75 gallons, the extra dilution will be in the same proportion, and the suspended solids in an inverse proportion, or a total, by this method of computation, of 100 tons of solids daily; and then, subtracting the oxidizable portion, of about 8 per cent., he arrives at 92 tons of solids at the outfall for twenty-four hours.

It is true that the analysis upon which this rests is open to more than suspicion of its accuracy, as shown by the analysis of English water-closet town sewage, which he fairly quotes; but it appears that American, or rather Western sewage is somewhat a peculiar product, as it is stated that in the precious case in which the specimens were transported "one bottle had broken and saturated the sawdust, and yet there was no perceptible odor when the box was opened," and yet the entire computation for Baltimore is predicated upon these samples of inodorless sewage from Memphis representing the average discharge from a population of 500,000.

Mr. Corfield is then quoted in favor of the irrigative method of utilizing sewage, but disregarding the varied circumstances and limited scale upon which sewage farms have hitherto proved at all successful, the system is recommended as likely to produce a considerable revenue to the city of Baltimore. Taken in connection with the provision of three pumping stations, one of four million, one of six million, and one of sixteen million gallons daily, we can only say that if the city of Baltimore ever realizes one dollar for the sale of her sewage, on the scale proposed, it will be that the experience of the past is no guide for the future; although, we will admit, that a certain proportion of the sewage may be found profitable—to the individuals using it, but not to the city taxpayers—and yet this fact should by no means be taken as an evidence that, in a sanitary point of view, the system proposed may not be a success; but we object to holding out the profitable pecuniary return of the enterprise to the taxpayers as an inducement toward the introduction of the system.

We quote from a scientific contemporary of the first standing in England as follows:

"To dispose of sewage at a profit has been tried over and over again with the utmost persistency and at an enormous cost. The result has been a complete failure. In certain isolated cases, where the quantity to be dealt with has been small, or where the conditions have been exceptionably favorable, a small profit has been made either by individuals, companies or towns, but all attempts to get rid of the sewage of cities, and to realize for these cities even a moderate profit on the cost of the necessary works as well, have been failures."

The estimated cost of the proposed works is $3,200,000, and we give it as it appears in the report, but a million or two more or less should have no weight in the selection of a proper system for a city which has such a future as Baltimore.

In the case of the city of Stillwater, the population is not stated, but the plan proposes nineteen and a half miles of small pipes, avowedly in imitation of Memphis, but in addition, for good reasons, viz., a hilly site, with rapid discharges, four miles of "combined" sewer is added—to carry off the rain-fall from an inch of rain in the hour—making altogether about the same extent of sewer as in Memphis; and we notice it as an illustration of the possible danger of generalizing from a few particulars. The site would appear to be hilly and broken up by steep ravines, and where the effects of heavy rains are said to have worked mischief heretofore; and yet, from the *presumed* success of the Memphis scheme, the same, or similar, method of sewering the city is recommended, with the addition of a few miles of combined sewer of house sewage and surface water.

We are reminded here of an anecdote which has its application to hasty generalizations. The owner of a sick horse, inquiring of a friend whom he knew had had a horse under treatment, "What did you give your horse, Jones, when he was sick?" Jones answered that he "gave him turpentine," which answer, satisfying the querist, he administered the same to his horse, with a fatal result. Meeting his friend Jones sometime after, he told him that he had given his horse turpentine, "and

* *Reviews of Sewerage Reports, continued from page 487.*

it killed him." "So it did mine," responded Jones.

The sewers proposed for Elmira, in this State, are on the combined system, but the rain-fall for which the sewers are proportioned is estimated as one-quarter inch in an hour, to run off in three hours, which amounts to five cubic feet per minute per acre, and during eight hours of maximum flow, the house sewage, with water supply of sixty gallons per head daily, is estimated to furnish one-quarter cubic feet per acre per minute, but is not regarded as requiring any additional capacity in the sewers, if they are estimated as running but two-thirds full with the rain-fall. The population is assumed as reaching twenty-eight individuals per acre, or eighteen thousand to the square mile. The present total population is about 25,000. The effort is to be made here to admit no more rain into the street basins than the sewers can carry off. Sewers to be ventilated by perforated man-hole covers, and untrapped basin shoots, and untrapped house drain and rain-water pipes.

(TO BE CONTINUED.)

BOOK NOTICE.

"Mills' Directory of Boiler Owners and Steam Users for New York and New Jersey." The J. N. Mills Publishing Company. 208 pp. 1881.

As the above title implies, this work consists of an accurately compiled list of the boiler owners and steam users of New York and New Jersey. In order to obtain absolutely reliable information, the publishers state that their agents visited the various towns and cities to carefully collect the names, occupations and addresses of all using steam. The work is alphabetically arranged, first by cities, then by names, and after each name is given the number of boilers used. It is of great use as a book of reference to all dealers in and manufacturers of steam engines and pumps, gauges, valves, pipes, injectors, etc.; boilers, grate bars, boiler covering, etc. The book is neatly and strongly bound.

EAST RIVER BRIDGE.

A communication was received by the trustees of this work from the chief engineer in response to the resolutions of the board of trustees some time since, to the following effect:

"*Resolved*, First—That the chief engineer be requested to explain the increase of 1,000 tons of weight in the iron and steel required under the contract with the Edge Moor Iron Company.

"Second—That he report whether he approved of such increase when made and still approves of it.

"Third—Whether the increased weight will affect the safety of the bridge or its distance above the water.

"Fourth—Whether the bridge, after this increase of weight, will be able to carry a Pullman parlor car or an ordinary elevated railroad train.

"Fifth—That he be requested to explain the change in the appropriations for the work, by which the cost was largely increased as claimed by the Edge Moor Iron Company, the reasons for such change and the total amount of increase of cost.

"CHIEF ENGINEER ROEBLING'S EXPLANATION.

"BROOKLYN, Dec. 1, 1881.

"*Hon. Henry C. Murphy, President of the Board of Trustees of New York and Brooklyn Bridge:*

"DEAR SIR: I beg to submit the following remarks in reply to the resolutions passed by the trustees at the October meeting of the board:

"The increase of 1,000 tons arose as follows: The change from iron to steel was forced through in such haste (less than three weeks) there was no time to calculate every part exactly. No less than 600 drawings had to be made for that and the last one has just been finished. The weights in iron were largely taken as a basis of calculation, but they proved fallacious. It was expected that steel would give us from 15 to 20 per cent. more strength than iron, and that it would weigh from 12 to 15 per cent. less, but actual experiment proved that we gained the strength, but the superstructure was actually heavier because the steel could not be rolled as thin as iron. This bridge is so large and has so many parts that the thickness of a shaving on all the parts would amount to several hundred tons. In reality 500 tons of the extra steel now called for should have been included in the original specifications, if not a single alteration or addition had been made to the original plans; 200 tons increase are due to full rolling and greater specific gravity of the steel than samples furnished. For instance, every floor beam weighs 450 lbs. more than calculated, 300 tons were added when I reduced the number of sizes of channels so as to enable the Edge Moor Iron Company to get through at all with their limited rolling facilities. The remaining 100 tons were added by reason of necessary minor additions and changes. The following changes have been made in the original plans of the superstructure. The first by the late John A. Roebling in the spring of 1869. It became apparent at an early day that, owing to the length and exposure of the bridge, three sidewalks would be unnecessary, so two were converted into roadways for vehicles by adding five feet to the width of the bridge. This increases the moving and dead load in the main span each 135 tons, and the total dead load 260 tons. This was provided for in the cables and anchorages, and partly so in the towers. Next, the order of the Secretary of War requiring five feet more head-room under the bridge had to be complied with, either by raising the grade five feet or by cutting five feet off the trusses below the floor. It was decided not to raise the grade, which was steep enough already, but to raise the trusses above the floor, as the least of two evils, and yet it was a matter of regret to be obliged to do it, because the first position was the most effective, the lightest and cheapest. This raising has led directly to most of the subsequent additions. Five years ago, when I made the calculations for the height of the cables above the water, I deemed it prudent to allow one foot for increased deflection, due to any extra weight that might in the future be added. This, under the circumstances, has proved just right, and the bridge when completed will fulfill all the requirements of the law as to height above water. Margins of safety, or, in other words, the ratio of the maximum load that may be borne by a structure to the ultimate strength of its various parts, vary all the way from three to eight, according to circumstances. The margin of safety in this bridge is still over four, which I consider safe.

"Commissioners recommended three for the Blackwell's Island bridge, while Mr. T. C. Clarke thinks eight not too much for ordinary railroad bridges. As a general thing, the greater the dead weight of a bridge in proportion to the moving load, the smaller the margins of safety can be. Nine-tenths of the bridges in the country have a margin of between four and five. In the anchorages, where we have to provide simply against the upward pull of the chains, the margin of safety is two and one half times. In case of the cables, however, we have to provide for numerous contingencies which cannot occur in the anchorages. For instance, allowance must be made for the deterioration of the wire by the elements, for many possible imperfections in the manufacture of the cables, for any increase of weight or strain over that first contemplated, and, lastly, a certain margin is required, so as not to strain the wire beyond its limit of elasticity. The deterioration of the wire by the elements is remote. Our cables have been made with such care, the dangers of imperfect manufacture have been practically eliminated. The anticipated increase in weight has taken place. I consider the margin of the cables as great as that of the towers. The anchorages have been sufficiently reinforced. The extra weight of 1,200 tons, which seems to have alarmed some, is in itself not so terrible; 500 tons of it comes on the main span, or 125 tons per cable, producing a strain of 200 tons on each cable. As the cable has a strength of 12,000 tons, this increase is not alarming. Twelve hundred of the total weight of steel comes within 100 ft. of the towers. None of this is supported by the cables, because the suspenders will be slacked off. Most of this rests on the connecting-wall by reason of the truss acting like a cantilever, and a small portion is supported by the stays. A good part of the weight beyond the 100 ft. is further supported by the stays. I said before, the margin of safety is over four. Even were it possible for the 1,200 tons to come all on the cable, the margin would still be over three and one-half, with the thermometer at zero, when the deflection of the cable is a minimum, and the temperature strains in the trusses a maximum. The strength of one cable is taken at only 12,000 tons, while Colonel Pain claims it is really 12,300 tons. This will increase the margin of safety above mentioned. As the elastic limit of straight tempered wire is considerable higher than that of ordinary wire, namely, 66 per cent., instead of 50 per cent., the margin of safety when referred to the elastic standard is over 2.64. In one respect an error of judgment has, perhaps, been committed. It was somewhat uncertain at first how high the steel could be taxed, so it was deemed best not to strain it beyond 15,000 pounds per square inch. I now think we could just as well have taken it at 20,000 pounds, which would have saved ten per cent. in the total weight of steel, but as an offset to this we have the steel in the superstructure, which is that stronger and will last so much longer. Even at 15,000 pounds some sections came out so thin they had to be thickened to keep them from rusting. All that I ever assigned to the supporting power of stays and connecting walls is one-fifth of the total weight of the superstructure. The bridge can carry a Pullman car or any ordinary elevated railroad train. The railroad track will bear at the rate of one ton per foot run, while the trusses have ample distributing power. In 1878, while the working drawings and specifications for the superstructure were being prepared, an agitation was begun to force the use of locomotives on the bridge. I did not approve of them on account of the grade and because they would pass so near the horses on the roadway as to greatly interfere with the carriage traffic across the bridge, and on account of the bridge not being strong enough to carry them. My objections were fully stated at the time by reports and numerous letters. Fearing that they might be used, in spite of all my opposition to them, I deepened and strengthened the floor-beams and put in an intermediate floor-beam. I also found that by adding one hundred tons to the main span I could raise the intermediate trusses to the level of the middle ones and make a cross connection on top, and thereby double the efficiency and yet leave head-room enough for elevated trains. It would have been well if we had stopped here, but it was discovered that a Pullman car had not head-room by nearly three feet. I held out for three months against this change, but in vain, and two hundred tons were again added to the main span, because all four middle trusses had to be raised, while the posts required extra bracing; most of this weight comes on the middle pair of cables which, from their position, have a little more to bear than the outer cables. We will now have a bridge so rigid that the ordinary daily traffic will have no visible effect on it.

"Respectfully yours, W. A. ROEBLING."

We think Mr. Roebling's statement requires very little explanation, so far as his individual responsibility for any changes made was involved.

It is not at all likely that any changes were made by him, involving additional expense, after months of persistent opposition to such changes on his part, unless by authority which he recognized as competent.

What that authority was, we may never know precisely, but, as a step in the right direction, possibly, we quote the answer of Mr. Stranahan to a remark of Mr. Roosevelt, "that he should like to hear some explanation of the statement of the chief engineer that he held out for three months against the alteration. I want to know who compelled him to make that change, as I have not heard that the board took any action in the matter.

"Mr. Stranahan—It occurred in this manner: There was a desire felt to have a bridge sufficiently strong and with a capacity equal to the passage over it of a Pullman palace car, or of a train of elevated railroad cars. A committee was appointed on the suggestion of Mr Haswell, who was then a member of the committee and felt in common with the other members of the committee, that the bridge should be equal to the passage of a Pullman car. We consulted with the engineer as to how that thing could be done, and learned that it only required that the trusses be made higher, or the brace across the top of the truss should have a bow in it, if you please to call it so, and it was thought by Mr. Roebling that it would be better to increase the height of the truss. I had no idea it would increase the weight of the bridge the 200 tons. I had no reason to think it would increase that amount, although I knew there would be an increase. Those are the facts. And now for my share of the responsibility. I am glad the thing was done, and I think every member of the board may rejoice in the fact that the capacity of the bridge is now equal to the passage of any train of cars that may pass over any of the roads in the country."

This statement was not satisfactory to Mr. Bush, who was in search of "authority" for the change made, having been assured that no resolution was adopted authorizing it, and that no committee had been appointed for the purpose of increasing the weight of the bridge. Mr. Stranahan's reply to this was, "that the report (presumably of the committee) was a written report, and had the approval of our board, and is on the minutes."

Here Mr. Trustee Roosevelt appears again in the same rôle we had occasion to comment upon in an article of the 19th of November; and it would look at first sight, that this patriotic New Yorker deplored the action of trustees and engineer in adding to the weight of structure, by *raising the height of the steel trusses, and thereby providing for Pullman and freight cars, draining the resources of the city of New York, and fertilizing the sandy plains of Long Island!* We quote him:

"Mr. Roosevelt—I met Mr. Charles H. Haswell, and asked him about this matter. He said he had never taken any action in regard to increasing the weight of the bridge, and was very much surprised that it had been done. It is possible, however, that both Mr. Stranahan and Mr. Haswell are mistaken. This is a very serious matter, as the board has placed entire confidence in the president, the vice-president, Mr. Stranahan and the Executive Committee, and although he did not say that confidence had been in any way misplaced, he thought it should be respected. The bridge will not only carry the Pullman cars, but will also carry freight trains; and if that was done, although it might benefit Brooklyn, it would add very much to the embarrassment already experienced in the crowded streets of New York. Then it will take trade away from New York and give it to Brooklyn; and it was a question that had to be settled whether the New York members were willing that should be done. He for one was not."

The thing is done, however, and we are in ignorance as to whom to thank for the fact that, between the trustees and the engineer, they have built better than they knew, and the effort, by resolution of Mr. Roosevelt, to forbid for all time

the passage of the bridge by freight trains was properly disposed of, and the public may rest assured that, when finished, the bridge will be used to its fullest capacity, which, so far from being lessened by the changes made, has been increased thereby fully 20 per cent.

We append the following official statement of cost:

Statement of the Financial Condition of the New York and Brooklyn Bridge on the 30th Day of November, 1880.

CASH RECEIPTS.

From the City of New York prior to June 9, 1875	$1,500,000.00
Under the act of May 14, 1875	2,421,900.00
Under the act of April 7, 1880	516,000.00
From the City of Brooklyn prior to June 9, 1875	3,000,000.00
Under the act of May 14, 1875	4,523,693.73
Under the act of April 7, 1880	1,033,333.33
For rent	185,882.33
Interest	50,852.43
Horses and harness sold	7,758.00
Wharfage	4,800.01
Materials sold	85,272.30
Scows sold	6,469.00
	$13,335,962.13

CASH EXPENDITURES.

For engineering, salaries, etc	$452,043.21
Office expenses, salaries, etc	152,758.07
Timber and lumber	445,647.05
Construction	2,299,834.51
Contingent expenses	65,955.95
Rent	75,620.85
Tools	20,104.83
Labor	2,189,556.96
Machinery	136,903.38
Freight, cartage and towage	35,038.65
Printing and advertising	12,571.41
Land, land damages and buildings	3,702,734.38
Limestone	608,041.37
Interest and discount	171,060.38
Horses, wagons and harness	19,903.33
Cast steel cable wire	623,733.16
Insurance	8,982.13
Granite	2,115,903.17
Loss on New York City 6 per cent. bonds	9,296.02
Loss on New York City 7 per cent. bonds	3,509.18
Taxes and assessments	6,068.27
Scows and repairs	31,008.36
Office furniture	6,216.77
Freight on account Collins Granite Company	435.31
Total	$13,323,155.08
Expended prior to June 9, 1875	5,388,646.06
Expended since June 9, 1875	7,934,509.02
Total	$13,323,155.08
Cash in Atlantic State Bank	12,224.83
Cash on hand in petty cash	581.62
Total	$12,806.45

CASH LIABILITIES.

Booth Bros	1,536.48
The J. A. Roebling's Sons Co	7,297.43
Edge Moor Iron Co	31,283.09
Cofrode & Saylor	4,298.01
Eppinger & Russell	1,596.18
Abbott Pavement Co	576.18
Edmund R. Andrews	664.55
Otto Lachenmeyer	100.16
Salaries for November	3,905.15
Percentage retained on materials received in November	3,544.44
Total	$95,846.61

NEW FRENCH AND ITALIAN METHODS OF GEODESY.

In our issue of Oct. 15 we gave illustrations of novelties in engineering instruments exhibited at Milan. The kind of theodolite invented by Professor Porro, and to which the name of tacheometer has been given on account of the facility it affords for logarithm tables and the great rapidity with which geodetical operations can be performed, has found some warm defenders, while some engineers think that there are other and better methods for attaining the results aimed at. For the better understanding of the subject we repeat the illustration of the instrument in question. The verniers are divided into 4,000 parts. Fig. 1, a smaller model in which they erniers are divided into 2,000 parts, is represented in fig. 2.

M. Kazimirski, who is chief engineer of Seudre France) Railway Company, wrote a long criticism on the Porro system in the *Génie Civil*, at the same time offering a remedy of his own. His letter found in turn a critic in M. Le Brun, chief engineer of the Isle of Reunion Railway. We translate both letters as containing subjects of interest to all engineers, and as matter calculated to evoke some criticism on the part of the profession in this country.

M. KAZIMIRSKI'S NEW METHOD FOR DRAWING MAPS AND TAKING LEVELS WITHOUT CHAIN WORK, OR TRIGONOMETRICAL CALCULATIONS.

A series of instruments has been devised for simplifying the preliminary surveys, for railway lines especially, but, despite the precision of those new apparatuses, we see operators always coming

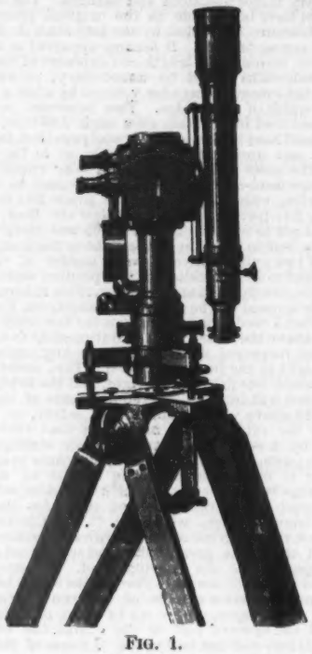


FIG. 1.

back to the routine methods for the simple reason that these instruments are more theoretical than practical, and necessitate for their use an amount

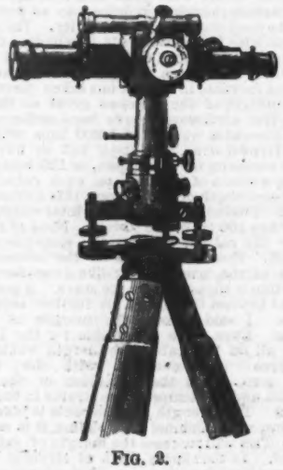


FIG. 2.

of knowledge which is lacking in the majority of engineers.

The improved theodolite of M. Porro has been adopted by a few enthusiastic specialists, but during the last twenty-eight years it has not grown in favor, and it will never become an instrument within the reach of every engineer. I believe that it has had its time.

Important State works are to be executed; the net of French railroad is judged insufficient, and it is therefore of interest to curtail the time for laying out the new lines. It is with this view that I propose a method which requires only a few hours for its mastery, and, if it only serves as a point of departure for other improvements, I believe it is worth explaining.

THEORY OF THE INSTRUMENT.

The new method which is applicable to geodetical instruments, etc., does away with the difficult part of the indoor work; that is, the calculations that are required to find the distance of every point, the level of which has been taken from the foot of the instrument, and also the calculation of the altitudes. The apparatus can be easily used by engineers, who are discouraged at employing the tacheometer, at present in use. THERE IS NO CHAIN WORK IN THE FIELD, AND NO TRIGONOMETRY IN THE OFFICE. Such are the advantages of the new graduation, which can be applied to the theodolite, the tacheometer, or any other instrument used in geodesy.

On the line AB, supposed horizontal and one meter in length, let us raise the perpendicular BC, divided from B to C in centimeters (fig. 3). Let us consider the point A as a center, and join it to the points m n, etc. We have then directions Am and An, representing, with relation to the horizontal line AB, grades of 0.01 meter per meter, for Am; of 0.02 meter per meter for An, and so on, for the other points taken on BC, and distant 0.01 meter from one another.

If from the point A as a center, we describe a circumference with any radius and that on AB prolonged we take a length $AB' = A\,B$; that, at the point B we raise a perpendicular $B'C'$, so as to repeat a symmetrical figure to that described, we shall have found the graduation of my circle by its cutting the lines Am, An, etc. *This circle, with those divisions which in the theodolite, for instance, will replace the vertical circle, divided into degrees, or equal angles* will enable us, when AB is horizontal, to set the eye-piece according to the known gradients or inclines of an analagous value when the division is *made below A B*.

Let us suppose that a leveling staff is placed at a certain distance, and that it can be seen with the eye-piece of the instrument and set horizontally.

Supposing that we read 1.457 meters. Let us then incline the eye-piece so as to read according to the gradient $A\,m$ of 0.01 meters, we have, for instance, 3.369 meters. The difference between the two readings will enable us at once to ascertain the distance of the level from the foot of the staff, this difference being 1.912 meters. We say that the leveling staff is at 191.20 meters, and we have only to change the decimal two places to the right and do away with chain work.

It is very easy to see that if we had to take the sighting following any other direction than the

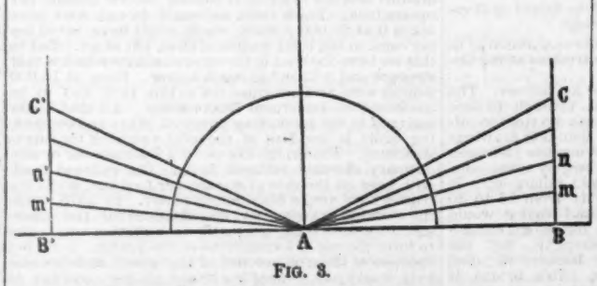


FIG. 3.

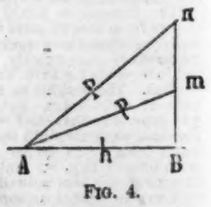


FIG. 4.

horizontal, which is peculiarly favorable, the work would be quite as simple on the condition of having two readings following to two contiguous inclines—that is, with gradients or inclines having no greater incline between one another than 0.01 m.

per meter. Here is the demonstration of the fact.

CALCULATING DISTANCES.

Let there be two lines passing through the point *A*, and situated on the same side as the horizontal line *AB* or *h*, and let them be cut at *n* and *m* by the perpendicular *Bn*.

Let us admit that the lines *Am* and *An* recede from the horizontal according to the inclines *p* and *p'*; that is, if *AB* were equal to 1 meter, *Bn* would be equal to *p*; or, to generalize the definition, that *Bn* would contain as many times *p* as *AB* will contain times 1 meter. This gives us:

$$Bn \text{ or } Bm + mn = h \times p'$$

on the one part, and

$$\frac{Bm}{mn} = \frac{h \times p'}{h(p-p')}$$

on the other part, whence

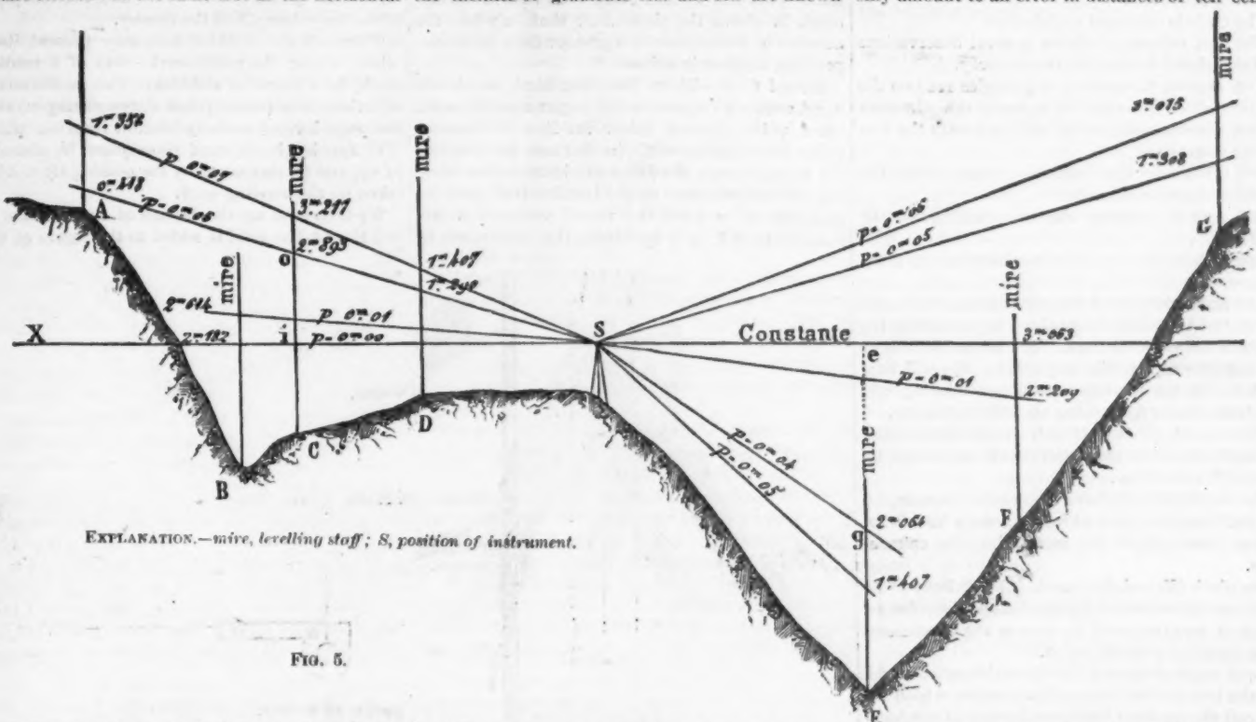
$$h = \frac{mn}{p-p'}.$$

By subtracting the equalities member by member we have a third equality, and from them we arrive at the value of *h*, which proves that in the above figure, when we know *mn* and when the inclines or gradients *Am* and *An* are known (let us call them *p* and *p'*), we have, in order to find the height *h* of the triangle *nmA*, or rather to calculate the meeting point of the two slopes, only to divide *mn* by the sum of the inclines if they are in contrary directions, or by their difference, if they are, as in this case, in the same direction:

$$h = \frac{mn}{p-p'} = \frac{1.912}{0.01} = 191.20.$$

When the reading is always made following two contiguous slopes, the difference $p-p'$ is always equal to 0.01 meter, which causes us to move the decimal, as in the preceding case, two places to the right. It is in this way that the instrument enables us to do away with chain work.

As readings on the levelling staff can be appreciated to nearly one millimeter, it may be said that the chain figures are sufficiently near, as a difference of one millimeter on the staff would only amount to an error in distances of ten centimeters. We can therefore class this instrument among the exact apparatus.

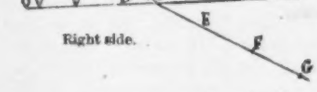


EXPLANATION.—*mire, levelling staff; S, position of instrument.*

FIG. 5.

CALCULATION OF ALTITUDES.

In order to show the ease with which altitudes can be calculated by the new method, I have

Points and Sketches.		Angle on horizontal plane	Declivities.	Reading on staff	Difference of readings.	Difference from staff to apparatus	Product of this difference by smallest declivity, M	Reading following smallest declivity, N	Sums and differences of columns M and N: Differences K	Sums L	Guide marks and true leveled points.	Horizontal plane X Y, or constant passing through axis of eye-piece.
1		2	3	4	5	6	7	8	9	10	11	12
 Left side. Right side.	Mark *A*	30°	+ 0.07 + 0.06	back 1.356 0.418	0.938	93.80	5.628	0.418	— 5.210		48.206	42.996
	Mark *B*	30°	+ 0.01 0.00	2.614 2.182	0.432	43.20				— 2.182	40.814	
	Mark *C*	30°	+ 0.07 + 0.06	3.217 2.803	0.324	32.40	1.944	2.803	— 0.949		42.047	
	Mark *D*	30°	+ 0.07 + 0.06	1.407 1.290	0.117	11.70	0.702	1.290	— 0.588		42.408	
	Mark *E*	210°	— 0.04 — 0.05	2.064 1.407	0.657	65.70	2.628	2.064		— 4.092	38.304	
	Mark *F*	210°	0.00 — 0.01	3.063 2.209	0.854	85.40				— 3.063	39.933	
The line *OO'* is the base of the operation.	Mark *G*	210°	+ 0.06 + 0.05	3.015 1.308	1.707	170.70	8.535	1.308	+ 7.227		50.223	
Sub details:	Mark *H*	45° 32′	+ 0.10 + 0.11	0.804 1.052	0.158	15.80	1.580	0.804	+ 0.686		43.082	
30° + 180° = 210° For prolongation following *EG* of direction *AB*.	Mark *I*	45° 32	— 0.10 — 0.00	3.286 3.931	0.643	64.50	3.805	3.931		— 0.736	33.260	

T T'

To pass from one station to another, it is only necessary to draw the line TT', and the table can be used as at beginning.

Remark 1.—The signs + and — show how to pass from the constant of column 12 to the altitudes of column 11 by *adding* or *subtracting* the values in columns K and L.

Remark 2.—In calculating the constant, we operate according to the plus or minus sign of the figures of columns K and L, to pass from the mark column 11 to this constant, which is written in column 12.

When the reading is always made following two contiguous slopes, the difference $p-p'$ is always equal to 0.01 meter, which causes us to move the decimal, as in the preceding case, two places to the right. It is in this way that the instrument enables us to do away with chain work.

As readings on the levelling staff can be appreciated to nearly one millimeter, it may be said that the chain figures are sufficiently near, as a difference of one millimeter on the staff would only amount to an error in distances of ten centimeters. We can therefore class this instrument among the exact apparatus.

CALCULATION OF ALTITUDES.

In order to show the ease with which altitudes can be calculated by the new method, I have drawn up the subjoined profile model, which will serve to indicate the different cases which may be met with in the course of an observation. A table to be used for the leveling memorandum books is also subjoined.

The cut represents a station supposed to be at *S*, and the double reading made on the staff at the points *A*, *B*, *C*, *D*, *E*, *F* and *G* of any profile.

Arrangement of the Memorandum Book.—The memorandum table recommended by M. Moinot,

Chief Engineer of the surveys of the Central Branch for the Orleans Co., is composed of 16 columns for the use of the tacheometer. There are only twelve columns in the new method for calculating the levels.

The table is arranged as follows:

The first column contains general observations and sketches for assisting the memory.

The second is reserved for angles read on the horizontal circle—that is, it gives the direction which connects the foot of the staff with the foot of the instrument.

The third is for the declivities from which the readings have been made.

The fourth contains the two readings on the staff.

The fifth is for the difference between the readings.

The sixth gives the horizontal distance from the apparatus to the staff, obtained by removing the decimal point or comma. The memorandum so far is kept exactly like any other. We will now see how we can do away with the calculating rule and trigonometry, by using the other columns.

The seventh column (*M*) will contain the product of the distance from the staff to the apparatus by the smaller declivity.

The eighth (*N*) will have the smallest reading on the staff repeated, and which is already in column 5, but here given for facilitating the calculations.

The ninth (*K*) and the tenth (*L*) will have: The ninth the difference of the numbers of the columns *M* and *N*, and the tenth the sum of the numbers of those same columns *M* and *N*.

The eleventh column will contain the guide-marks and the true leveled points. The twelfth, which we will call *the constant*, will give the side of the horizontal plane passing through the center of rotation of the eye-piece, and corresponding to the plane of sight in the Egault and Lemoir instruments.

Use of the Table.—The operator must understand the necessity of showing in column 3 of the sights the declivity on which every reading has been made, and the *positive* or *negative* sense of this sighting with relation to the horizontal plane *XY*, passing through the axis of rotation of the eye-piece. For this reason the numbers of the declivities must be preceded by the signs + or −, according to the case.

Column 6.—We know that to get the figures of this column we have only to multiply by 100, the corresponding figures of column 5 of the differences.

Calculation of the Altitudes.—It must be fully understood that the column M (see profile and table) represents the quantity of which the visual radius runs off vertically from the plane *XY* of the constant. We thus see at once that to calculate the altitudes, we must begin with that of the constant.

CALCULATION OF THE CONSTANT.

Let us begin at the beginning and consider the case of the back sight on the guide-mark *A*.

First Case.—The reading having been made by means of a positive sighting, that is to say, above the line *XY*, or by a negative sighting, that is, below it.

In our rough draft we will take the point *A* as our guide mark. Its altitude, 48.206, we know.

From what we have said the number 5,628 meters (column 7), shows that the visual radius meets the staff at 5.628 meters above *X Y*. Let us subtract 0.418 meters, and we have the distance 5.210 meters, which must be taken down from the guide-mark *A*, to get to the plane *XY*.

The figure of the plane *XY*, that is to say, of the constant, is therefore given by the difference between 48.206 meters of the mark, and the number 5.210 of column 9, or 43.096.

Remark.—It was to obtain this number, 5.210 meters, more easily that the reading 0.418 of column 4 was carried into column 8, or N, alongside column 7, or M, and that the sign—was placed before the number to indicate the required operation. This will be done every time that the guide-mark is above the plane *XY*; that is when the number in the column M is greater than its corresponding number in column N.

Second Case.—If, on the other hand, we should have, even with a positive sighting as a guide-mark, some point situated below the line *XY* (such a point, for instance, as *C*), in that case the distance *CI* being exactly the difference between the reading *CO* = 2.893, made on the leveling staff, and the quantity *IO* = 1.944, the visual radius of which rises above *XY*, it is by adding this difference to the figure of the guide *C* that we obtain the figure of *XY*.

From the look of the table, the reading (column 3) having on the one hand been positive, and the figure of the column M being smaller than that of column N on the other hand, we might conclude (see profile) that we had to deal with a point *below* the plane *XY*.

Our guide mark for point *C* would be	42.047
Let us add	0.949
And we have the constant	42.996

It may be stated, *en passant*, that in our table, as the point *A* is used as a mark, the point *C*, like the rest, forms a part in the same station of what we call the fore sights. I only adopted it in the preceding explanation for the purpose of analysing the figures in the table.

It is shown, therefore, that when a back sight is taken with a positive sighting, the plane *XY* is always at a vertical distance from this point, which is equal to the difference of the figures in columns M and N, and that this plane *XY* is below the leveled point, when the side of the column M is greater than the corresponding one of column N, while the plane *XY* is above the leveled point when the column N is the greater.

Third Case.—A third case may present itself when taking the guide-mark—that of a reading made in a negative sighting. The profile model will then show (as per point *E*, for example,) that the point leveled is always distant from the plane *XY*, first by the value of the column M, that is, by *eg*, and furthermore, by the reading *Eg* = 2.064 taken on the leveling staff.

We then sum up the figures of the columns M and N and the total is added to the figure of the guide and we obtain the position of the plane of the constant, 4.692. Let us add the sum of the columns M and N to the true number of the point *E*, 38.303, and we have the constant again, 42.996, whence the rule:

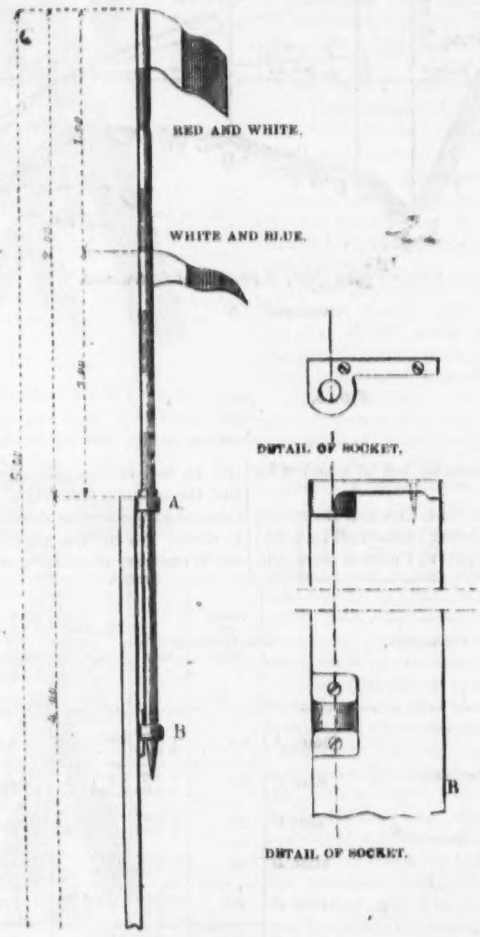


Fig. 6.

General Rule.—1. When the mark is perceived in a negative sighting, which is found indicated in column 3 of the inclines, the constant is obtained by adding the figure of the mark to the sum of the figures of columns M and N.

2. When the mark is perceived with a negative sighting, the difference between the figures of columns M and N is taken and added to the mark, when N is ⊏ M, and subtracted when M is ⊏ N.

Remark.—It must not be lost sight of that the signs + and — of columns K and L (ninth and tenth) of our table are not given for the purpose of calculating this constant, but in order to show how, with the constant, we can obtain the true height

and the leveled points by the addition or subtraction of the values in the columns.

CALCULATION OF THE LEVELED POINTS.

The constant once obtained, it is easy to calculate the other points by keeping in view the signs + or — of columns 9 and 10. The three cases which must be studied for fore sights are the following:

First Case—Where Points are Perceived by Means of Negative Sights—All these points are below the line *XY*, and at an equal distance from the sum of the columns M and N. The figures of

FIG. 7.

these columns will therefore be added and the sum written in column *L* (tenth) with the sign preceding the total, which will show that this value is to be deducted from the constant in order to obtain the figure of the leveled point (as in points *E* and *I* of the table). It may be incidentally observed that points *H* and *I* of our table (see sketch, column 1,) are leveled in another direction than that

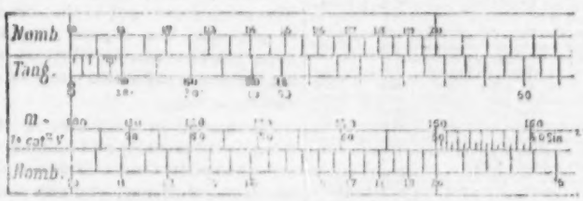


FIG. 8.

of the profile model, which is seen from the indication of the angle 43° 52′ of column No. 2.

Second and Third Cases—Points Perceived with Positive Sights, and which are Above XY, as Point G, or Below, as Point C—In these two cases we must make the subtraction of the two columns M

FIG. 9.

and N, since this difference (see profile) will always indicate how far the point is vertically distant from *XY*; but when the column M is greater than N, the point will be above *XY*. The difference found will be placed in column K (the ninth), with the sign + to prepare the addition of this figure with that of the constant.

In the case of point *C*, on the other hand, the greater value being column N, the difference will be taken, and written, preceded by the minus sign in column K, to facilitate the subtraction of 0.949 from the figure of the constant.

Remark.—We may add that the points perceived with the sighting at 0.00, or horizontal, as *B* and *F*, will follow the same method as for levelings made with the ordinary levels, and that their true figure will be obtained by deducting the reading of the horizontal sighting from the value of the constant. It is this reading, 2.182, preceded by the sign — which can be brought into the tenth column (L).

From the above we arrive at the following rule for calculating leveled points:

General Rule.—1. For all negative sightings add up the columns M and N, indicate the result with the sign — in column No. 10, or L, and subtract from the constant *XY*.

2. For all positive sightings, make the subtraction of the columns M and N, make use of the sign + for the result when M is greater than N and the sign — when N is the greater, inscribe these results in column K and finally add the + and subtract the — from the constant already found.

Remark.—It is seen that the calculation of the figures of column M will be much easier by make use of the horizontal sighting, and by taking in preference, as often as possible, readings from the declivities 0.10, 0.20, 0.30, etc., since in such cases the column M can be found by removing the decimal and by simply multiplying.

Observation.—At a distance of 100 meters two successive readings on contiguous declivities require a field on the staff of 1.00 meter. To use the instrument in the most unfavorable cases, as in a wood, where only 0.50 meter of the leveling staff can be perceived, it will be requisite to indicate the division of slopes of 0.005 metre.

Again, in this case, after taking the differences of the readings made on the leveling staff, we obtain the chain work by removing the decimal, but we must multiply the product obtained by two.

Let us return to the case already considered, and allowing that the directions of the sightings have followed declines, the difference between which was only 0.005 m. per meter.

We should then have for the distance by chaining, according to the formula:

$$\frac{3.369 - 1.457}{0.005} = \frac{1.912}{0.005} = 382.40$$

or

$$\frac{1.912 \times 2}{0.01} = 191.2 \times 2 = 382.40$$

In a word, after subtracting the two readings, remove decimal two places to the right, and multiply by two.

In this, as in the other cases, the altitudes will be calculated by the general rule.

All the work now performed by the tacheometer in use can be had by the new apparatus, or with theodolites and tacheometers on the new system, more rapid work can be done in some instances—the building of a dike on a river can be examined at any moment of the day.

Again, suppose we wish to send a staff man to plant a stake across a river and at 134.80 meters. He crosses the river and places the divided rule on the other bank. For the first trial, the operator takes two readings, and finds that the staff is only at 122.30 meters. He gives a sign and the man places the stake twelve or fifteen paces farther. Two new readings are taken, and the distance is found to be 132.60 meters. The staff man then measures 2.20 meters with the staff, and we have the distance required.

We find in the *Genié Civil* a very interesting letter from a civil engineer at Saint Denis (Reunion), which we translate as follows:

"Mr. Kasimyrski, in criticising the tacheometer Porro, says that this system has had its time and he proposes another. The remarks which he makes on the matter are certainly ingenious, but they refer to only a few special cases.

M. Moinot, in the first edition of his work on the subject, had unnecessarily complicated the question. Since then he has rectified this mistake, and his method must now be considered as the most rapid, economic and simple of all. I have taught it in a few hours to young men just from school and who, in a few days, became good operators. If they did not understand the theory at first, they knew at least the practical part. M. Kasimyrski only indicated, as it were, planimetry, and his system cannot differ much from that in general use, and if he suppresses trigonometry, he renounces at the same time to bring forward the highest summits of the survey to their rectangular co-ordinates, and thus deprives himself of one of the greatest advantages of tacheometry.

He replaces the ordinary graduation in degrees on the vertical circle by a graduation according to the tangent.

In the Field.—With his method for determining a point we must have two pointings, each according to the division of the limb, and which have been made beforehand. We must also have two readings on the limb, two readings on the leveling staff; and we have to take note if the sightings are above or below the horizon. With the old system, all we require is a single pointing on the best point of the leveling staff; two readings on the limb, two readings on the leveling staff—one of which can always be made on an exact number of yards. The use of zenith angles does away with the necessity of sighting. The advantages of the old system are: there is less work, two operations fewer, greater rapidity of reading and less risk of mistakes.

Calculations.—The method in question does away with the reduction of horizon distances, and also with calculating rules.

One of the great advantages of the tacheometric system, in my opinion, is to have the calculating rule, which reduces the time for numerical calculations by two-thirds. If we admit its principle—calculating the reduction of distances, and multiplying by the tangent, and effected by a single movement of the rule—the time employed is the same in one case as in the other.

We thus see that the method presented to us has not as many merits as the old system. But it can be of great service when we have no calculating rule. But we should have not only the division in degrees on the instrument, but also the division according to the tangent, as is almost invariably the case with English instruments.

We must borrow two other improvements from them. They have their instruments furnished with everything necessary for making observations night and day. This facilitates operations in tunnels, gives the determination of the meridian, and of longitudes and latitudes. Their instruments are of a dark, green bronze, while our instrument makers still continue to give their instruments the best polish possible—a fact which gives a great deal of trouble when using them in hot countries. The instrument might also be profitably used in countries where no detailed map has been made, for distances over 700 meters—which is a superior

limit to that given by the stadia. Of course, we can arrive at the results by a triangulation, but this requires long calculations, and, moreover, it is not possible if the point we have to fix is only visible from a single station.

If this point is accessible, we send a man with a leveling staff, and if necessary with a directing staff of two meters, with which a height of six meters can be observed (Fig. 6).

This leveling staff being put up, we can observe the zenith angles V and V', Fig. 7. We have then:

$$d\ cot.\ V = AN$$
$$d\ cot.\ V' = AM$$

Whence

$$d\ (cot.\ V - cot.\ V') = AN - AM = h,$$

which gives the regular relation,

$$d = \frac{h}{cot.\ V - cot.\ V'}$$

which can be easily calculated by means of the common trigonometrical tables. But it can be calculated as easily by means of the rule. We see, in fact, that

$$cot.\ (V - V') = \frac{1 + cot.\ V\ cot.\ V'}{cot.\ V' - cot.\ V}$$

and consequently

$$\frac{cot.\ V - cot.\ V}{cot.\ (V - V')} = 1 + cot.\ V\ cot.\ V$$

Observing at the same time that there are only a few minutes difference between V and V', we can say

$$cot.\ V\ cot.\ V' = cot.^2\ \frac{V + V'}{2}$$

and placing

$$V' - V = \delta,$$

the formula will become

$$d = \frac{h\ cot.\ \delta}{cot.^2\ \frac{V + V'}{2}}$$

$$1 + cot.^2$$

adding, moreover,

$$1 + cot^2\ \frac{V + V'}{2} = m$$

we have

$$d = h\ \frac{cot\ \delta}{m}$$

a formula which can be easily calculated by the rule. To do this, we have to draw on the line of the lower part of the rule, which has the square sinus, the values of m, which correspond to the different values of V, comprised between the ordinary limits of vision, 50 and 150 degrees (Fig. 8.)

As the tacheometer gives angles to a centesimal minute to (0.01°), we see that, with a leveling staff of 6 meters and a vision between 70 and 130 degrees, we can have an approximation of at least 5 per cent. of the total distance as far as 2,000 meters.

If the point is not accessible, or if the distance is further than 2,000 meters, the method is, however, at fault; but if, as Mr. Porro proposes, we add a trismatic square to the tacheometer, we can measure distances up to 8 or 10 kilometers.

Let us suppose that this instrument in A (Fig. 9) be $AB = l$ the distance to be estimated. We have then to find out by the square a point C, so that the angle ACB be a right angle, which can be made very approximately if the square has a good sight. We then mark the point C with a directing staff, we measure the angle α, the distance d to the middle of the stadia, and we have in the rectangle triangle ABC

$$l = \frac{d}{cos.\ \alpha}$$

The base d should have the greatest possible length—if we give it from 25 to 30 meters we can judge distances from 8 to 10 kilometers.

This system enables us to draw up plans for railroads, etc., in a country for a radius of about 10 kilometers, with a satisfactory approximation, and at the same time have a tolerably good map of the country.

HIS ANNUAL RAMPAGE.

We cannot forbear quoting at some length an extract from a late report of Chevalier C. Baillairgé, Chief Engineer of the City of Quebec, on the "Amelioration of its Aqueduct," as illustrating a line from Horace, "Cœlum, non animum, mutant qui trans mare currunt," and the boldness of a city official in exposing the truth of what most of us have seen elsewhere, and but few have had the courage thus to express.

"Occupy the attention of the City Council with the advisability, or the contrary, of retaining 15 days of a man's salary, a miserable $25 from an employé of 36 years standing, who had grown gray in the city service, half a month's salary for having had to lay up after getting badly beaten by a lot of rowdies, while on the contrary it is he who has an undoubted right of action for damages against the city whose police on that occasion and every other is, from want of numerical force, powerless to do the needful.

"Discuss the advisability of a coal-oil lantern in an unfrequented and dangerous locality; that of an expenditure of $7 in relation to the hand of the French frigate, and God only knows what else of a like nature.

"Oh! it is not singular, gentlemen, that the public should be indignant, as they justly are, and threaten the very existence of an institution capable of occupying its deliberations with measures of like importance.

"The public does not want this, the cutting down of the charwoman's wages by 10 cents, those of the fire wood purveyor by 20 cents. Refuse to pay a party his just due and then pay capital and costs together. Capital and costs in a hundred pending suits against the city for injury to life and limb of man and beast, injury to vehicles, because you will persist in believing, or affecting to believe and trying to impress the public with the fact, that a corporation employé can do the work of ten men in other cities. I must stop, for God only knows what I might not add under the legitimate indignation I feel while contemplating a mal-administration, which, if it did exist previously to 1880, has but increased and since become more marked, more accentuated, and has at last attained its apogee under the pretended reformers of the municipal concern, elected by an intelligent ward of the city which has been led astray by the false representations of one man in particular, he of whom one of the judges of the —— Court, as good a physiognomist as he is a judge of everything else, says (and if he did not say it I should do so myself) that the moral element is entirely wanting, notwithstanding a certain talent he may be possessed of as a public writer and stump orator.

"Most assuredly it is not in this way you will do honor to the municipality. Have done with all such trifles, worthy at most of occupying the attention of a village council. Apply yourselves to something worthy of deliberating on. Elevate yourselves to the position of representatives of one of the oldest and most important cities of Canada. Restore your laborers' wages, put those of your officers back to their former figure of 1878, unless you further increase them, which you should do in the true interests of the city. Take on the necessary hands to do the work, and that nothing may be neglected as things are at present, and for the purpose of collecting the revenue, together with all arrears which without such aid will remain a dead letter.

"Effect a loan, lay down a second line of pipe, consolidate the city debt. You will thereby in course of time save $100,000 yearly in interest and sinking fund. Settle immediately with the government the subscription in favor of the Q., M., O. & O. R. R., that in favor of the Lake St. John railway, the cession of the Palais harbor.

"Be not formalized at my telling you so. If I am your employé, remember that I am also like yourselves a citizen, and that, as you are now, I was in 1861 deputed by the municipal assembly for a term of three years and unanimously re-elected for a second term of like duration. Listen not to that portion of the city press which in its ignorance, error and bad faith, advises you not to allow yourselves to be lectured by me, and does so only with the view of fomenting hatred and discord in the municipal camp.

"On the contrary, gentlemen, it pertains to me who have been here for twenty years as deputy and engineer, and who knows as much and more of municipal affairs than any other man in the city, to impart such knowledge to my neighbors. Do not forget that, like you, I am an interested proprietor, and that, as such, I cannot give you bad advice or counsel things improper without being with you a victim to my own erroneous teachings."

A VALUABLE BOOK.

How many engineers and surveyors are content to operate upon the surface of mother earth without a thought as to her real shape and dimension, or the process through which our present knowledge of the subject has been reached. Without going into the more abstruse problems of geology, Prof. Merriman has given us, in his little book, the substance of a course of lectures on the figure of the earth, delivered to the civil engineer students in Lehigh University, and is properly an introduction to the science of geology as illustrating the steps through which our present knowledge has been acquired and the difficulties in the way of an extension of that knowledge. It is not addressed especially to the scientific student, whether engineer or surveyor, but it is so far popularized that there are few persons of ordinary intelligence who may not read it with profit and certainly great interest.

The day fixed by ordinance for submitting the question of water-works under the existing contract to the people of Hamilton, O., is Dec. 24, 1881.

PERSONAL.

F. de Funiak, General Manager of the Louisville & Nasville Railroad, was in the city this week.

Mr. Donald Allen has been duly installed Division Superintendent and Engineer of the Texas Central Railroad, with headquarters at Waco.

Geo. A. Morison, Mem. A. S. C. E., Chief Engineer of the Bismarck Bridge, on the line of the Northern Pacific Railway, has returned to the city to remain until next spring.

Gen. Theo. G. Ellis, Mem. A. S. C. E., Hydraulic Engineer, of Hartford, Conn., has been spending the week in this city, on business connected with an important patent lawsuit.

The Railroad Conductors' Convention at New Orleans elected R. B. Brown, of the Louisville & Nashville Railroad, President for the ensuing year, and decided to hold the next annual meeting at Milwaukee.

Messrs. Cushman & Fairleigh, Civil Engineers formerly of Illinois, in which State they were extensively engaged in railway surveying and construction, have opened an office in Chattanooga, Tenn., with very encouraging prospects—that city being one of the principal centers of the coal and iron trade in the South, and its rapid growth and progress being inevitable.

There is considerable gossip concerning the suit of the Keeley motor stockholders against Keeley, to compel him to give them information regarding the apparatus. Keeley's nephew, who is his companion in the workshop, is skeptical of his uncle's invention, and says he often heard him say there was more money put in the thing than can ever be got out. The nephew says the engine has never yet been run by vibratory power, and during the recent exhibition a sort of quicksilver was used.

The arrival in the Servia of Mr. Franklin B. Gowen will probably add interest to the suit just brought by Mr. Daniel Dougherty as counsel for Mr. James McHenry, who asks damages from Mr. Frank S. Bond, the President of the Reading road, who, in an interview in a Philadelphia paper, is alleged to have said: "Mr. Cave, Vice-President, is an idiot, and don't know what he is talking about. He is the mouthpiece of Jim McHenry, the veriest vagabond that walks London streets, and a notorious stock-jobber."

In an engineering point of view the entire line of the Texas Pacific Railroad from Fort Worth to Blanco is of the most interesting character, and even a layman could not fail to be impressed with the magnitude of the work, the genius with which all difficulties have been met and conquered and the thorough, careful manner in which every inch has been constructed. And in this place honor to whom honor is due. Major D. W. Washburn, the chief engineer of the Improvement Company, a young man, but a worthy pupil of the great engineer whose lieutenant he is, and full of capacity and genius, has had entire supervision of the construction of the line, and it is but just to say that the magnificent work that he has accomplished entitles him to a place in the highest rank of railway engineers.

A curious and interesting contest is being conducted in Columbus, Miss., by the Standard Oil Company. Three years ago the merchants at that place asked the company to vary its prices according to the market, and upon being refused, combined together and bought oil from other quarters. The Standard Company then lowered its rates, and finally put a local agent into the field to undersell the merchants at retail, but still the latter refused to surrender, and to this day have handled none of the company's goods. Finally the monopoly has put a great quantity of groceries into the town to be

sold at cost, and a small dealer who had built up a petty business in chipping dried beef for his customers had to see the great company set up an opposition grocer next door to punish him for refusing to sell its oil. The merchants of a small town can hardly be expected to hold out against warfare of this kind. It is to be hoped, however, that their struggle will not be without good results.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 489.)

CLIII.—QUEBEC.

Quebec, Canada, in lat. 46° 48′ N., long 71° 16′ W., is on the St. Lawrence River on a promontory at the mouth of the St. Charles River. The point, called Cape Diamond, is 333 ft. above the river. The upper town is an elevated table-land, and the lower town is a narrow belt along the St. Lawrence backed by a cliff, and a strip on the St. Charles about 2,000 ft. wide, of more gradual ascent.

Founded in 1608, it was incorporated as a city in 1841. Water-works were built by the city in 1853, after the plans of George R. Baldwin, C. E., taking the supply from the St. Charles River at Lorette, 9 miles from the city, 486 ft. above the St. Lawrence, and 150 ft. above the highest point in the city. A stone dam across the river, 200 ft. long, 14 ft. high and 6 ft. wide at top, diverts the water into a subsiding reservoir. The water-shed of the river at this point is about 500 square miles. About 3 miles above the dam the river widens into Lake St. Charles.

From the reservoir the water is conveyed 40,969 ft. in an 18 in. cast-iron pipe to the city. In passing under the St. Charles River near the city the pipe was imbedded in timber and concrete 5 ft. under low water. In 1872 it was found that the pipe leaked from a portion of a lead joint having blown out, and that there was a hole 1½ in. in diameter in the spigot end of the pipe in that joint. The jet from this hole, which was under a pressure of 210 lbs. per square inch, had cut 3 in. into the wood-work of the box and nearly through a 7-in. post. The pipe was repaired by banding it with a cast-iron sleeve with lead joint. Within a year the jet had cut through the sleeve a hole 2 in. wide. The defective pipe was then cut out and replaced. Afterwards the main was carried across the river by a pipe-arch bridge of 120 ft. span, surrounded with wood.

As early as 1860 there were complaints of insufficient supply. Experiments by T. C. Keefer, C. E., showed excessive waste, the lowest average night delivery in April being 88 per cent. of the highest average day delivery. The tubercular corrosion of the main diminished the supply also.

In 1865 G. R. Baldwin, C. E., found that the main was virtually reduced by incrustations from 1.50 to 1.28 ft. diameter. There were then 3,035 taps, and the consumption as measured was 3,000,000 gallons under the existing arrangement of throttling certain sections for portions of the day, while a constant supply at the rate of consumption in the several districts when under full head of water would have required 7,200,000 gallons per day.

Distribution is by cast-iron pipe, of which 27.5 miles are in use, of from 14 to 4-in. diameter, mainly of 4-in. There are 222 fire hydrants, 112 gates and 5,016 taps.

The population in 1880 was about 50,000, and the daily consumption about 3,000,000 gallons.

The works have cost $1,300,000, the amount of the bonded debt. The gross receipts have been about $2,000,000. In 1880 the expenses of maintenance were $70,000 and the revenue $90.000. The City Engineer, C. Baillairge, C. E., has been the manager of the water-works since 1866.

CLIV.—NASHVILLE.

Nashville, Tennessee, is in lat. 36° 10′ N., long. 86° 49′ W., on the south bank of the Cumberland River, on rocky bluffs, rising from 80 to 175 ft. above low water. The town was settled in 1779; incorporated as a town in 1806. In 1832, the population being 6,000, water-works were built by the town, after plans of Albert Stein, C. E., taking water from the river and pumping it by a direct-acting steam pump of 26-in. cylinder with 96-in. stroke, into a reservoir on the hill, of 3,000,000 gallons capacity, and a stand-pipe 100 ft. high.

In 1878 two duplex Dean pumps were erected. Distribution is by cast-iron pipe, of which 42 miles are in use of from 36-in. to 2-in. diameter.

No statistics of the number of hydrants and taps have been furnished.

The population in 1880 was 43,461, and the daily consumption 6,000,000 gallons.

The works have cost $1,500,000, and the gross receipts have been $1,215,227.20. The expenses in 1880 were $65,667.93, and the receipts $64,541.42.

There was no bonded debt until 1880, when a loan of $75,000 was created, bearing 6 per cent. interest, to extend and improve the works. Jas. Wyatt is Superintendent.

CLV.—AKRON.

Akron, Ohio, in lat. 41° N., long 82° W., is on the Little Cuyahoga River, on the highest ground between Lake Erie and the Ohio River, 495 ft. above the Lake, and 1,065 ft. above sea level. The town was settled in 1825.

Water-works were built by a private company, in 1880, after the plans of Joseph Flannery and E. J. Frost, civil engineers. The supply is taken from a bed of water-bearing gravel. A brick well, 50 ft. in diameter, the walls, from 30 to 18 in. thick, resting on a cast-iron shoe, was sunk 32 ft. by excavating from the interior and allowing the curb to settle by its own weight. The water stood 16 ft. deep in the well.

Two Worthington engines, one non-condensing, of 1,000,000 gallons capacity, the other a duplex-condensing engine of 1½ million capacity are provided, pumping through 2,500 ft. of 16-in. pipe into a reservoir on Sherbondy Hill, still in excavation and embankment, 250 by 200 ft. and 14 ft. deep, lined with 18 in. of puddle on which is laid a pavement of sandstone blocks laid in cement.

Distribution is by cast-iron pipe, from 16-in. to 3-in. diameter, 20 miles of which are in use, 6¼ miles being of less than 6-in.

There are 157 fire hydrants, 40 gates, 600 taps and 10 meters. The city pays $45 per year for each fire hydrant.

The population in 1880 was 16,512. The delivery of water to consumers began on May 19, 1881.

The capital stock of the company is $250,000, and there is a bonded debt of $200,000.

Edward J. Frost is the Secretary, Treasurer and General Manager.

CLVI.—LEADVILLE.

Leadville, Colorado, in lat 39° 15′ N., long. 106° 20′ W., is at the head of the Arkansas River, near the summit of the Rocky Mountains, 10,500 ft. above the sea. Settled in 1878, it was incorporated as a city in 1879, in which year water-works were built by a private company. The supply is taken from a stream in Big Evans Gulch, which has about 16 square miles water-shed, heading in the Mosquito Range. A dam in the gulch, a mile and a half from the city, forms a reservoir 300 by 200 ft., and 16 ft. deep. From this a line of 2,300 ft. of 12-in. and 5,364 ft. of 6-in. pipe conducts the water to the distributing tank, 185 ft. below the dam and 164 ft. above the city. It is of wood, 40 × 20 × 16 ft.

A Knowles pump is also connected with the tank by a 4-in. pipe, drawing its supply from springs in California Gulch.

Distribution is by cast-iron pipe, of which 3 miles are laid, with 52 fire hydrants, 21 gates, 250 taps and 2 meters. Lead service pipes are used.

The population in 1880 was 14,820, and the daily consumption about one million gallons.

The capital stock of the company is $300,000, and the bonded debt $65,000, bearing 8 per cent. interest. The total receipts from April, 1879, to Oct. 1, 1881, were $68,500. The expenses in 1880 were $12,402.15, and the receipts $30,722.85.

H. W. Lake is the Secretary, Treasurer and Superintendent, and J. C. Cramer the General Manager.

(TO BE CONTINUED.)

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GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Newark Water Company, of Newark, O., capital $200,000, was incorporated last week.

Geo. F. Bramhall, C. E., formerly an assistant on the Chicago water works construction, is again before the people of that city with his Aqua-Port.

Corry, Penna., is agitating the question of a public water supply and a system of sewers; the project is not, however, so far along as to have a recognized leadership in the matter. They are waiting for the "coming man" to promote it.

So many citizens of Santa Barbara, Cal., discontinued the use of gas and employed kerosene that the gas company announces that if the people will continue and resume their patronage it will reduce the price from $6 to $3 per 1,000 feet.

Orange, N. J., is discussing the question of erecting water-works. It is thought that they can be built for $80,000 or less, and the town counsel has given his opinion that the law of 1876 will authorize issuing the necessary bonds.

Hornellsville, N. Y., has entered into arrangements with the Warren Pipe Works, of Philipsburg, N. J., to supply the village with water through 100 double hydrants, at a cost not to exceed $30 per hydrant; also, free water to all the village buildings, schools, etc., and one drinking fountain for man and beast in each ward. The reservoir will cover an area of 30 acres, and be capable of holding 60,000,000 gallons.

The Meadville Water-works, of Meadville, Pa., have been running their machinery since their formation by water-power; but, owing to scarcity of water last season for about two months, they have decided to put in steam. The engines and boilers are made by the Phœnix Iron-works, of Meadville, and are of 150 horse-power. The cost of the change will be $6,000.

A special meeting of the Newport, Ky., Water-works Board was held on the 3d to receive bids for additional pumping machinery. The two propositions were for an engine capable of pumping 3,000,000 gallons of water per day, or for two engines with a capacity of 2,000,000 gallons each. Bids were presented only from Cope, Maxwell & Co., of Hamilton, Ohio, and the Holly Manufacturing Company, of Lockport, N. Y. The former firm made a proposition to furnish two engines of the capacity mentioned for $74,500, or one engine with the power to furnish three million gallons per diem for $55,000. The Holly Company proposed to furnish two two-million gallon pump engines for $51,500, or one three-million gallon pump engine for $48,000. The matter was laid over for due consideration.

STREETS, DRAINAGE, ETC.

The city of Houston, Texas, has decided to pave its streets with wood, and contracts are called for.

Northampton, Mass., wants sewers, and Mr. Waring is on the lookout for their construction.

The sewerage problem is receiving consideration at the hands of Canton, Ohio, tax-payers just now. The prevalence of malarial fevers in and about Canton calls for some action toward establishing an efficient system of sewerage. Councilman Archival has submitted a resolution to the city council to appropriate $50,000 to be used in the construction of a sewerage system similar to that now in use in Memphis, Tenn. This was recommended by Mr. George E. Waring, Jr., of Newport, R. I., who made a thorough inspection of the geological surroundings of Canton last spring. No action has yet been taken on the resolution, and it is probable that the matter will be submitted to a vote of the people. Some object to it on account of the expense, but the ever increasing growth of Canton will soon compel some action in the matter.

BRIDGES.

ST. LOUIS, Dec. 8.—While a freight train eastward bound on the Western Division of the Wabash Railroad was crossing the bridge over the Missouri River, at St. Charles, about six o'clock this evening, the eastern span of the bridge gave way, and the entire train, composed

of thirty-two cars, thirteen of which were laden with live stock, was precipitated into the river about eighty feet below. The engineer is missing, but everybody else on the train escaped.

RAILROADS.

An action has been instituted in the Supreme Court of the State of New York, to be tried in Monroe County, by Isaac S. Waterman, of Philadelphia, and Henry A. Taylor, of Rochester, contractors and builders of the Rochester and State Line Railroad, against William H. Vanderbilt, its former manager, for the recovery of $1,000,000 damages alleged to have been sustained by reason of a breach of contract on the part of the defendant.

At a meeting of the stockholders of the New York and New England Railroad, Dec. 6, the Jay Gould party were chosen directors by a vote of 94,000 out of 96,000. The following are the new directors: Jesse Metcalf, Jay Gould, Sydney Dillon, Cyrus W. Field, W. T. Hart, James H. Wilson, James H. French, F. C. Fitz, Geo. T. Roberts, H. J. Jewett, L. B. Cannon, Fred. J. Kingsbury, R. Suydam Grant and Henry L. Higginson.

The New York *Sun* says: The Canadian Pacific Railway Company is making a great effort to sell its 5 per cent. bonds in this market. As the only security it offers at present for the interest as well as for the principal consists of wild land in the remote north of the continent, investors will hardly care to pay par, which is the price asked, for a security of such doubtful value. Their experience with the old Northern Pacific Railroad bonds is not yet forgotten.

Mayor Grace, in transmitting to the aldermen a communication from Messrs. Butler, Stillman & Hubbard, of this city, relative to the protection of the rights of the city in the proceedings now pending in the matter of the Broadway Underground Connecting Railway Company, said: "I have grave doubts as to whether the construction of an underground road under Broadway would not be a serious detriment to the interests of the city, but in any event I am satisfied that no such structure should be built, except upon condition that the manner of its construction meet with the approval of the Mayor, Comptroller and Commissioner of Public Works. To appropriate the core of Broadway for railway purposes would be to deprive the city of a valuable property needed for public purposes, and would necessarily interfere with the entire pipe and sewer system of the street. I should be pleased to concur in any legislation to protect the interests of the city which your honorable board may be pleased to pass."

The Pennsylvania Railroad Company opened its new depot at Merrick and Filbert streets, Philadelphia, on the 5th, for general traffic, and all trains are now run over the elevated road into the heart of the city.

The Gulf, Colorado & Santa Fe Railway, opened its whole length on the 2d inst., was organized in 1873 by Galveston men, and its mother was necessity. The mercantile interests saw that a road owned by Galveston was a safety-valve. After many meetings and canvassing for subscriptions the road began surveying lines and then locating. Aug. 1, 1880, the road was open for business between Galveston and Brenham, 126 miles. Nov. 1, 1880, the road was opened to Milano Junction, 174 miles, and connecting with the International & Great Northern Railway; on Dec. 1, 1880, to Cameron, 186 miles, and on March 1, 1881, to Belton, 226 miles. Thus it will be seen that between Aug. 1, 1880, and March 1, 1881, 100 miles were built, the difficulties of earlier stages of building to Brenham having been overcome. The distance from Galveston to Fort Worth is 345 miles. Including the eight miles of main line from Temple to Belton, the road from Temple to Fort Worth being the branch, the Santa Fe operates today 353 miles of road, penetrating 12 counties and passing through ten old-established towns, viz.: Richmond, Bellville, Brenham, Caldwell, Cameron, Belton, Clifton, Meridian, Cleburne and Fort Worth. Besides these the road has eighteen towns of its own and a few infants coming on. The road penetrates the ridge between the Brazos and Colorado rivers, a section second to none in the State, and now feeling the effect of railway facilities in the way of rapid settlement. The road is hailed with delight by Fort Worth, as it establishes a competitive line to Galveston and Eastern markets.—*Galveston News.*

NEW PROJECTS.

The Toledo & Detroit Air-line Railway Company; capital, $1,000,000.

The Indianapolis Construction Company, of Washington, O., and Indianapolis, Ind.; capital, $100,000.

A surveying party left New Orleans on the 3d to go over and locate the route of the proposed New Orleans, Red River & Texas Railroad, the objective point of which is Palestine.

The Austin & Northwestern Narrow Gauge Railroad surveying corps were eight miles above Liberty Hill, Tex., on the 1st, and were moving in the direction of Burnet.

Articles of incorporation of the Chicago & Peoria Railroad Company have been filed. The capital stock is $3,000,000 and the incorporators and Board of Directors are T. D. Catlin, E. C. Lewis, H. L. Glover, H. S. Hawley and A. L. Griffin.

The Fond du Lac, Wis., county board have voted to erect a new court-house costing $65,000—$35,000 is to be provided for in the assessment for the present year, $25,000 in the assessment of 1882, and $15,000 in the assessment of 1883.

The printed specifications of the new Austin Tex., capitol building, with form of contract and description of capitol lands, were completed in pamphlet form on the 1st. The contract is an iron-clad arrangement, which at least one intending bidder declares he would never sign.

Col. Victor K. Miles, chief of the locating party working on the Trinity & Sabine Railroad, was at Palestine, Tex., on the 1st. Two lines are located, one running from Red Branch, on the International, to Caney Creek, the other from Trinity Station to the same point, which is the junction of lines run thus far.

The plans for the building of the Methodist Episcopal Hospital have been adopted. They were prepared by Mr. John Mumford, who will receive the prize of $400 for them. The hospital is to cost between $400,000 and $500,000. Mr. Geo. I. Seney has given 240,000 of that amount. The hospital will be built on the block bounded by Seventh and Eighth avenues and Sixth and Seventh streets, South Brooklyn.

The Central Tunnel Railway Company of New York filed articles of association on the 7th. The capital is $5,000,000. The road is to commence near the City Hall Park, and terminate near the Grand Central depot, and will be five miles long, connecting with the Fourth Avenue Improvement. It will run under Chambers, Reade, Elm, Spring and Great Jones streets, Lafayette place, Astor place, Eighth and Ninth streets and Fourth avenue.

Redfield (Iowa) people are very enthusiastic over the prospect of the Minneapolis & St. Louis Railway coming to our town. As soon as they heard the surveying party was coming this way, a meeting of the citizens was held. A committee was appointed to go to Perry and consult with the engineers. The survey is now completed through the town, establishing their crossing over the Des Moines Northwestern track about twenty or thirty rods east of the depot.

A new railroad company has been formed under the name of the Arizona & Nevada Railroad and Navigation Company. Its object is the construction of a line between Callville, Nev., and Yuma, with extensions by rail or water, as may hereafter be determined, to Port Asabel and Libertad, on the Gulf of California. The capital stock is $20,000,000. The San Francisco directors are P. Peckham, John N. Risdon, John Lloyd, Robert N. Risdon and J. W. Smith. The Arizona directors, Paul Brion, John J. Gosper and Frank Staples; and W. H. Stymus, of New York. The road will pass through a line of rich mining districts.

The capital stock of the Bennington Cut-off, Middletown Springs, and Lake Champlain & Lake Ontario railroad companies has been taken, and the stockholders of the three companies will meet on Jan. 17 to organize and prepare for the work of construction. These railways together will form a system between Boston, Chicago, and Canada by way of the Grand Trunk and other Canada railways; also, between Boston and Montreal by way of the Hudson Canal Company's railroad and the waters of Lake Champlain and railway connections; also, between Boston and Rutland over the Bennington & Rutland Railway west and north of Hoosac Tunnel, and the Massachusetts Central Railroad on the east of the tunnel, and extending from there to Boston. At Boston connections are to be formed with a line of ocean steamers between that city and Liverpool and other places in Europe.

The Leavenworth, Olathe & Southern Kansas Railroad company was organized on the 5th. The corporators are E. P. Wilson, Joseph Whittaker, H. D. Rush, S. F. Neely, Matt Ryan, J. W. Craucer, M. H. Insley, T. A. Hurd, of Leavenworth; Henry Hopkins, of Lansing; J. Harris, of Olathe, and Tom J. Anderson, of Topeka. This line will tap the Missouri, Fort Scott & Gulf and the Santa Fe & Olathe. It will also make a direct line from Leavenworth to Memphis, Tenn., as soon as the Gulf road is finished to that point. The road is to run from Fort Leavenworth through Wyandotte, Johnson, Miami, Franklin, Anderson, Coffee, Woodson, Greenwood, Butler and Cowley counties. When completed, with branches in Wyandotte and Johnson counties to the State line at Kansas City, the road proposes building a branch from Atchison to Leavenworth.

The application for a new railroad charter, to be made at the next session of the Connecticut Legislature, which was referred to yesterday, undoubtedly appertains to a scheme which has been on the tapis for some time, and for which surveys are being actively made. The parties interested in the new scheme are keeping their plans to themselves for the present, so far as they are able, but we understand that the public will be soon let into their secret if the surveys prove as favorable as expected. From the few items of information allowed to transpire, we learn that it is proposed to construct and equip a line of railroad between Boston and New York far ahead of any now running between these cities, and even superior to any road in the country. It is claimed that the distance, via the new line, will be only 180 miles, and that, as the road is to have no grade-crossings whatever, is to be almost straight, and capable of maintaining a speed of 60 miles per hour, it will only require three hours to run between Boston and New York. Fifty millions is said to be about the estimated cost of the new enterprise.—*Boston Journal, Dec. 8.*

The proceedings of the Yonkers Rapid Transit Company for the right of way into the city of Yonkers have been completed, and the commissioners appointed last September have made their reports as to the right of way which the company seeks to acquire. The new line is to leave the New York City & Northern Railroad near the southern part of the estate of Augustus Van Cortlandt, and continue in a northwest direction, always keeping easterly of Broadway. The company proposes to begin building immediately, and the work will be pushed rapidly to completion. After leaving Getty Square the road will be elevated on a structure similar to the elevated railroads in this city for about 1,200 feet, and thence it will be a surface road. The engineering of the road, in respect to its grades, curves, ironwork and masonry, has all been planned with a view to rapid transit, and the line as at present laid out, from Getty Square to Kingsbridge, by the New York City and Northern Railroad, is about three-quarters of a mile shorter than by the Hudson River Railroad route. The commission have awarded about $100,000 as a just compensation for the property taken and damage done within the limits of the city of Yonkers. That portion of the line which is within the limits of the city of New York has been condemned for about $20,000.

The Jacksonville *Union* announces that the early building of the Jacksonville, Tampa and Key West Railroad is assured, and that Jay Gould, Samuel J. Tilden, Governor Cornell, Winslow, Lanier & Co., Milton Weston, of the Chicago Belt Line Railroad, and other capitalists have taken the matter in hand and will push the road to completion. The road will run on the west side of the river to Palatka, and thence direct to Tampa. A steam ferry is to be established from Palatka to a point on the opposite side of the river, and a road run from there to Titusville, a distance of over one hundred miles. The contract for grading this branch of the road has been let to a firm in Ohio, who have arranged with parties in Georgia to furnish 1,000 men to do the work and are to have the grading completed by the first of April. The contract for building the road from Jacksonville to Tampa will be let, when the work of grading will be at once begun, and it is the intention of the company to have the road completed in six or eight months. The roads are to be of the standard Northern gauge, and at an early date a branch road will be run from the main line to Key West via Punta Rassa, and a line of first-class steamers put between Key West and Havana. The headquarters of the road will be established at Jacksonville, where all of the machine shops, etc., are to be erected, and negotiations are now making for suitable ground for a terminus.

CONTRACTING, MISCELLANEOUS, ETC.

Hallanin & Mober were the lowest bidders on the construction of the shaft and tunnel at the new waterworks at Hyde Park, Ill., and the contract was awarded to them at $14.75 per foot.

The Hamilton, O., County Commisioners have accepted the Trenton bridge work done by McKeon & Flenner under their contract. The whole cost of the work done by the contractors amounts to $17,068.22.

A contract has been signed between the Baltimore & Ohio and Buffalo, Pittsburgh & Western railroad companies for the interchange of business, the latter road to build an extension 186 miles from Newcastle, Pa., to Chicago Junction, where it connects with the Baltimore & Ohio, thus giving the latter an outlet to Lake Erie.

The closing of Tone's bayou, which was about completed according to government specifications, broke on the 1st. The amount of damage is not known, it being some distance below Shreveport, but the river fell in a few hours three feet. There has been about $35,000 expended on it.

A company for the improvement of Green's Pond, at West End, Long Branch, into a lake has been formed. Surveys have been finished and contracts for excavation and other work will soon be let. The Brokaw Brothers, Astor Place and Fourth Avenue, this city, are at the head of the enterprise. Frank H. Earle, C. E., Jersey City, is the engineer. The tract to be improved covers about seventy acres, and probably $50,000 will be expended. There is to be a 200 feet bridge, to be built over the lake. Contract not yet let. Matthias Wooley, Long Branch, is the man to address.

The Grand Rapids and Indiana Railroad Company let the contract for building the northern extension of its road from the present northern terminus to the Straits of Mackinaw. The successful bidders were L. A. Rose, of Bronson, and McDonald Bros., of Grand Rapids. The terms of the contract are that the road is to be completed by Jan. 18 next, and it is expected that passenger trains will be running to the Straits by July 15.

Construction on the Texas-Mexican railroad has begun to the extent that dirt has been turned on the bay front at Caronkaway in the location of a bridge site. Mr. Gardner, General Manager of the road, is expected to arrive in Galveston any time between the 1st and 10th of this month, and general construction will commence immediately thereafter. The work will be started first at Galveston, and afterward will probably be begun at San Diego and Victoria. The track will be laid with new steel rails the whole way through. The bridge across West Bay will be about 12,000 feet in length, and will be pressed to completion as fast as possible to make it a first-class piece of work. Chief Engineer Fuller is in San Antonio looking after the survey of the line from that place to Beeville. He will return here about the last of this week. General Palmer is now in Europe in the interest of the company, and is forwarding supplies with all possible dispatch. Material of all kinds is arriving both at Galveston and Corpus Christi, and is being pushed to the front with all the speed that men and steam can accomplish. The steamer Nettie will leave here to-day for Corpus Christi, laden with three locomotives and other material for use on construction in Mexico. Track is laid on the west side of the Rio Grande a distance of about ten miles from Laredo, and will, it is thought, reach Lampasas by March 1.